TECHNOLOGY TRANSFER STRATEGIES FOR SMALL FARM MECHANIZATION TECHNOLOGIES IN THE PHILIPPINES

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ABSTRACT

There is no guaranteed procedure to ensure the transfer of any technology because of the variability of situations and conditions surrounding popularization and extension of technology. Some important initial considerations in mechanization technology dissemination are careful assessment in identifying mechanization needs and prescribing the appropriate machinery or set of machinery. Equally essential is the approach on how we attempt to have our farmers 'adopt or adapt' the technology we offer. This paper presents some problems and experiences associated with the extension of such technologies. Also, the strategies and other possible approaches, which could aid in penetrating the barriers toward small farm mechanization in the Philippines, are discussed.

Key words: Philippines, appropriate technology, strategies, small farm mechanization, technology transfer, extension strategies

INTRODUCTION

In the Philippines, the transfer of agricultural mechanization technology has been a very slow process. Before the 1960s, the level of agricultural mechanization in the country was mostly dependent on human and animal power. A decade later, a multitude of machinery have already been imported for adoption. However, these machines were designed to favor large contiguous hectares of land and were then utilized solely by big farm enterprises.

With the continued technology generation and the growing capability of our local machinery manufacturers, we then tried designing and adapting small imported machinery, equipment, and other technology to suit our own needs and conditions. These proved to be an effective means of increasing the level of machinery use in the farms and gave birth to the concept of "appropriate technology" or in our special case, "appropriate agricultural mechanization technology." This has been a catch-all phrase for all agricultural tools, machines, and implements that are simple, cheap, and can be locally serviced or manufactured.

The main criteria which should be considered during the development are that these machines should be suitable for use in small farms, easily repairable and maintainable, inexpensive, and environmentally friendly. The word "appropriate" should be interpreted as appropriate to the farmers in terms of their needs and affordability (Salokhe 2003).

The Philippine government has long been striving to achieve modernization of the rural sector. To date, the latest major enactment by the government is the Republic Act (R.A.) 8435 of 1997, popularly known as the Agriculture and Fisheries Modernization Act (AFMA). It prescribes urgent related measures to modernize the agriculture and fisheries sectors of the country in order to enhance profitability and to prepare for the challenges brought about by globalization. Section 59 of this Act gives priority to the development and promotion of appropriate agricultural machinery and other agricultural mechanization technologies to enhance agricultural mechanization in the countryside.

Even with such programs and strategies, coupled with prior institutional changes to boost the level of mechanization in our farms, positive change has been diminutive. Difference in the level of agricultural mechanization in the Philippines from 1968 to 1990, as reported by the Regional Network on Agricultural Machinery (RNAM), was merely 0.322 hp/ha (PCARRD 2002). In 1998, the agricultural mechanization level for rice and corn farms was reported as 1.68 hp/ha (Rodulfo et al. 1998).

INSTITUTE OF AGRICULTURAL ENGINEERING AND AGRICULTURAL MECHANIZATION DEVELOPMENT PROGRAM

The Institute of Agricultural Engineering of the College of Engineering and Agro-Industrial Technology, University of the Philippines Los Baños (IAE-CEAT, UPLB) is recognized by the Commission on Higher Education as the center of excellence in agricultural engineering. The institute has a three-tier function of instruction, research, and extension. Research and extension activities of the institute are mostly conducted through the Agricultural Mechanization Development Program (AMDP). AMDP is a major advocate of mechanizing farming systems in the country. For years, AMDP has been in the forefront of introducing and promoting appropriate mechanization technologies and practices for the farming sector (Capareda et al. 2002). Its mission is to contribute toward the mechanization of agriculture and fisheries through the generation of mechanization technologies. By providing machines and equipment appropriate for Filipino farmers' farms, the program envisions making these farmers to be at par with their counterparts in the developed world (AMDP 2002).

BARRIERS TO SMALL-SCALE FARM MECHANIZATION

Agricultural mechanization occupies a special nook in the hearts and minds of people concerned with development. However, mechanization as an effective partner of progress and socioeconomic well being still has a long way to go. A better understanding of its many ramifications can be likened to watching the interplay of the varying hues and shades of a rainbow that makes definite observations truly difficult (Latin 1985).

There is no absolute guideline for transferring mechanization technology, nor is there a tailored set of strategy to promote the adoption of agricultural machines. Variability of the conditions and the needs of the farmers limit the creation of a standard approach to disseminate mechanization technologies. In order to suggest appropriate strategies for small farm mechanization technologies, we first have to reflect on the problems associated with mechanizing small farms in the Philippines (Fig. 1).

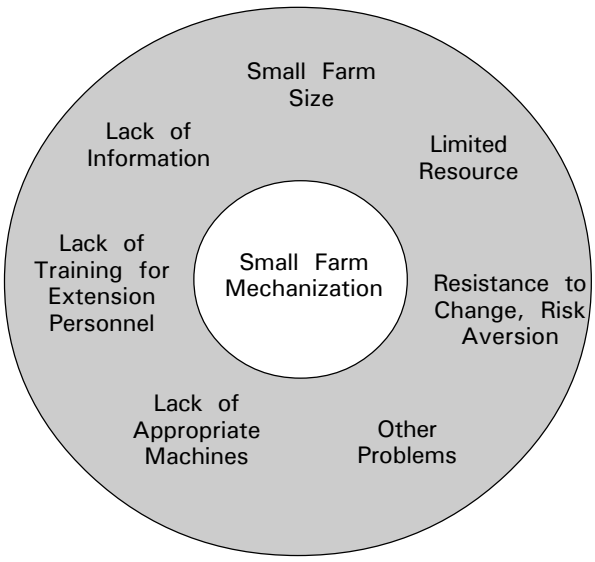

Fig. 1. Barriers to small farm mechanization.

Lack of Information

Information is the key to making sound decisions. Some farmers are unaware of the availability of a suitable machine, tool, or implement that could aid in their usually tedious work. They might be secluded from the technology by natural barriers and sociopolitical boundaries. Sadly enough, some farmers are even lackadaisical and seemingly uninterested in mechanization.

One simple tool for example is the AMDP manual corn sheller. This manual corn-shelling gadget has been available for so many decades but due to lack of information, the corn farmers of Barile, Cebu, have been using the traditional method of hand shelling which is inefficient, slow, and painful to the wrist and palms of the sheller. Barile, Cebu, is one of the corn-growing areas in the Visayas Region where corn serves as the staple food. Upon the introduction of the technology, most farmers of the cooperative shifted from the traditional method to the use of the AMDP manual sheller. The technology did not only make corn-shelling operations easier, faster, and efficient, but also made the farmers happier owing to the saved time and reduced wrist pains and blisters.

Likewise, it is a big possibility that some extension agents are oblivious of mature technologies that could be appropriate to their area of responsibility. Whenever extension personnel visit our machinery pool, someone would always be enlightened with the simple machines on display.

Limited-resource Farmers

Around 27 million Filipino farmers remain poor. About one-half of them live in the rural areas. Highest poverty incidence is found among corn farmers (41%); rice and corn workers (36%); sugarcane farm workers, coconut farm workers, forestry workers (33%); and fishermen (31%) (PCARRD 2003). These farmers have limited resources and are unable to readily embrace technology. Even with the availability of credit from banks and non-banks, these are seldom patronized by farmers because of the fear of debt. Contributory factors to this fear may be high interest rate, long processing time, and sometimes, the requirement for a collateral or a guarantor.

The Rural Farmers and Agrarian Reform Support Credit Program is implemented by the Department of Agrarian Reform and the Land Bank of the Philippines (LBP) through the donor agency, the Japan Bank for International Cooperatives (JBIC). LBP interest rates range from 14% to 18% per year, while moneylenders and traders charge 60-120% per year. Yet, many farmers prefer the non-bank sources for support. This is because of the lesser time to process the application, minimal documentary requirement, and timely release of the loan (RASCP-TA CMO 2002).

Small Farm Size

Of the 4.61 million farms recorded in 1991, 78% of these were less than 3 ha. Also, from 1991 to 2002, there was a 2.36% reduction in the number of farms (BAS 2004). Indeed, the majority of the agricultural farms in the Philippines are small and the reduction in number may be due to land conversion to satisfy the housing, industrial, and recreational needs of the growing population.

A small-sized farm is a big issue when it comes to mechanization because this is against the principle of economies of scale. The mechanization of small, non-contiguous parcels of land may prove to be inefficient especially in operations like land preparation and harvesting.

Reluctance, Resistance to Change and Risk Aversion

In our experience, the Filipino farmers are calculating and generally reluctant to changes in their farming activities for this is their way of life. They have the “wait-and-see” attitude. Although many farmers are very much open to new ideas and technology, there are more farmers who would first want to see a working model or system before they follow the lead. Many would think that this is psychological in nature. In reality, the more progressive farmers are the ones with more resources.

At times, the unfavorable attitudes and orientation of farmers caused by risk in adopting locally manufactured equipment is rooted in their bad experiences with agricultural machinery.

Lack of Appropriate Machinery (Design and Quality)

Even if as much as 80% of the farm power is provided by human beings, there is still a need to develop simple, manual equipment for various farm operations. In most developing countries, the human labor force comprises as much as 60% women workers. Thus, the proposed appropriate machine designs should be based on the ergonomic limitations of the individuals (Salokhe 2003).

Research and development (R&D) has a bias against the development of appropriate machinery for small farms. Scientists and engineers have a tendency to create something that is novel, without much regard to small farm applications. Recognition for developing appropriate machinery for small-scale application is not as glorious and rewarding as it is with creating a bigger, more complex machine or system.

In terms of quality workmanship for the local manufacture of machinery, majority of our manufacturers are still in the "cut-and-weld" level of manufacturing technology. This limits the capability of our machinery manufacturers in designing and fabricating machines. Also, the availability of low-cost, low-quality machinery in the market could be disastrous to our objective. The purchase of a low-cost, low-quality machine may, in the end, be a liability owing to frequent repairs on the unit (Amongo 2001).

Second-hand, imported machinery influx is also a problem. However, these machines are attractive to farmers because of their lower initial cost. But because these are not locally manufactured, replacement parts may be hard to find. Furthermore, conditions for which the machinery was designed for may not be suitable to the local conditions.

Lack of Training of Extension Personnel

Extension is the battlefront of technology transfer. The people involved in extension must not only be technically updated but must also possess good management and interpersonal skills. With so much on their shoulders, most of them might be lacking the capability to integrate the mechanization technology into the total farming system.

In a survey conducted, extension staff felt that their training courses had not been long enough to provide an in-depth treatment of the topics. This in turn affected farmers, since the courses missed out on a number of details which might have been very useful to them. In an effort to supplement the information transmitted in training courses, the Department of Agriculture (DA) sponsors regular national television programs (Encanto 2000).

Other Problems

Political interference. The government has been allocating funds for the development of the countryside, including the mechanization of farms. However, some politicians use mechanization projects for their own interests especially in areas where agricultural development is not the priority of the local government. They only use mechanization projects to source out funds; actual implementation is sometimes not realized. Aside from this, if the project is implemented, the acquisition of machines or other technologies is sometimes being dictated by political leaders who may not have the technical background, often resulting in the mismatching of technologies.

Institutional weaknesses. Problems in the overall organizational structure obscure accountability. The DA secretary is ultimately responsible for the performance of the sector, yet he does not have effective control over agricultural R&D budgets and management. The research community blames slow technological progress or the weakness of the extension system, not realizing that much weakness stems from the lack of profitable new technologies to extend. Since neither the Department of Science and technology (DOST) nor the state colleges and universities (SCUs) are held accountable for agricultural development and are independent of the DA, there is no effective pressure on the research system, in general, to improve its performance through more efficient allocation of resources. Even within the DA, the multi-functional, commodity-based structure and autonomy of several major commodity agencies make it extremely difficult to effectively manage and monitor performance of the research units under its umbrella (David 1995).

BREAKING DOWN THE BARRIERS TO SMALL FARM MECHANIZATION

After identifying the major problems that hinder the transfer of mechanization technology, we now try to identify strategies or means so that we could penetrate these barriers. Fig. 2 illustrates some strategies to accomplish our objective.

Information Dissemination and Management

A popular phrase in a local news segment is that "knowledge is power." Information is the key to making sound decisions. It is this information that we need to impart to our farmers so that they may be able to have better control of their lives.

Information dissemination activities through tri-media, displays, farmers' day, and the like, should be actively pursued in the countryside where these are wanting. Conducting such activities in the metropolitan area would be like "selling ice to the Eskimos." Actual field demonstrations and loan-out of prototypes are conducted right at the farmers' field or at pilot areas.

With the rich culture of the Filipinos, we have gained a lot of traditional or indigenous agricultural knowledge. Incorporating this knowledge into the mechanization system would limit farmers' reluctance to the mechanization technology. Popularized versions of training and technical materials in the local dialects would promote better understanding of these materials.

A centralized information database for the Philippines, linking all information concerning agricultural mechanization that can be accessed by farmers, extension personnel, scientists, engineers, students, and policy makers would

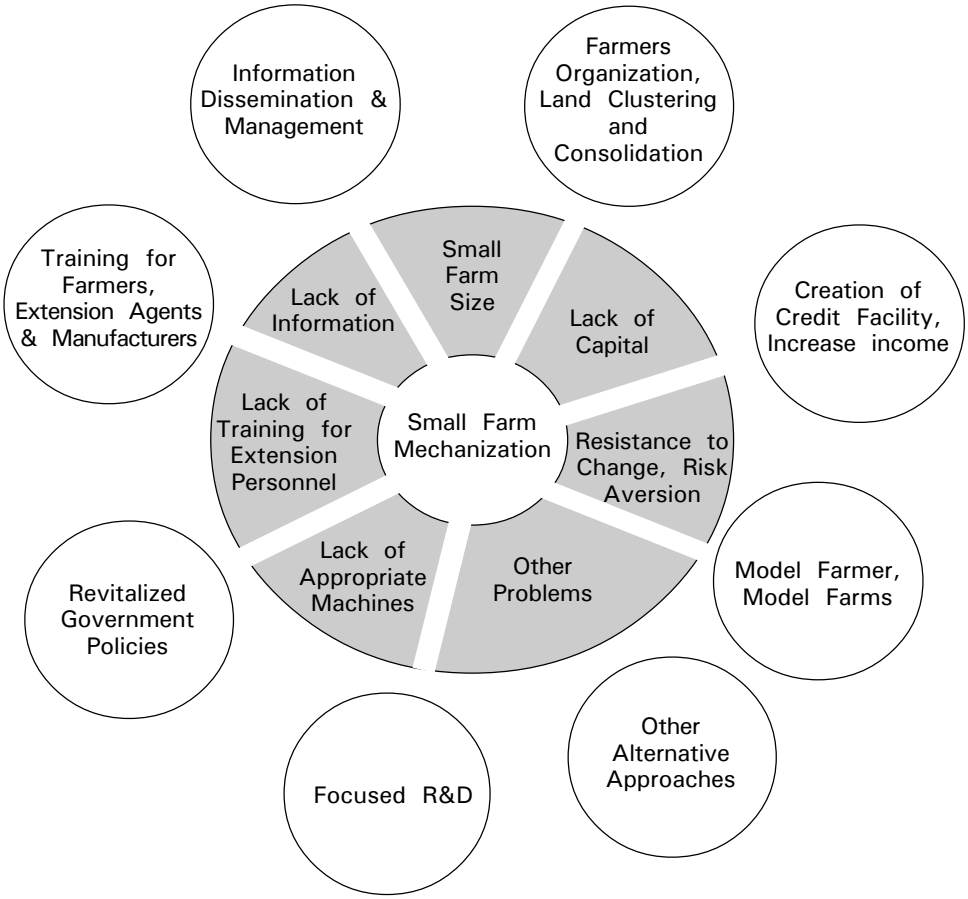

Fig. 2. Breaking the barriers to small farm mechanization.

greatly contribute to the transfer of the technology.

Creation of Farmers' Organizations

Encouraging and helping farmers put up their farmers' organization have been an effective approach toward development. With the formation of an organization, the farming community can be empowered with the knowledge and skills to identify its needs and problems, harness its resources to deal with this problem, and take action collectively. Furthermore, it is the take-off point for some of our strategies. Technical support, facilitation of credit assistance, land clustering and consolidation, and the like will not work without cooperation among farmers. Also, the farmer's organization is the usual entry point of developmental programs by government and non-government organizations (NGOs).

The premise for land clustering and consolidation is to transform the land and facilitate the adoption of larger-scale mechanization rather than fitting the mechanization technologies to small farms.

The DA-Region 2 initiated the clustering projects for corn, a step toward full-scale land consolidation under the Philippine setting. Clustering involves the removal of fences and other obstructions along farm property boundaries to form a contiguous land area that will increase the efficiency of operation of large machines to synchronize land preparation, planting, and harvesting; minimize turns at headlands and other interruptions; and reduce energy inputs. Land consolidation, on the other hand, improves land clustering by refining the layout of the fields in the clustered area without regard to property boundaries (Lantin 2003).

Focused R&D Activities

Due to increasing cost of fossil fuel, priority should be given to develop technologies to harness nonconventional sources of energy. More energy-efficient machines such as cultivating machines to incorporate plant residues into the soil to increase fertility, seeders and planters for optimum planting uniformity, crop protection for rationalized use of chemicals, and harvest and post-harvest operations that include village-level processing of farm products and by-products need to be continuously developed (Rodulfo and Geronimo 2004). Philippine Agricultural Engineering Standards, ergonomics, and environmental impact should be special concerns for R&D work.

Training for Farmers, Extension Agents and Manufacturers

The education and training of farmers and operators are at times inadequate and need intensification by both government agencies and machinery-manufacturing firms. The R&D results are not reaching the intended end-users and, therefore, could not create the necessary impact in the countryside.

Local manufacture of agricultural machinery can be promoted through trainings on village-level craftsmanship, manufacturing technology, operation, repair, and maintenance. Local manufacturers can be provided with technical assistance in the fabrication of machine prototypes.

Extension agents should have ample time to learn a technology before they can effectively teach others. If this is not realized, extension work would be like "the blind leading a blind." Extension personnel may need more training than our farmers to garner credibility.

Model Farmers, Model Farms

Farmer leaders are often emulated by their co-farmers. Farmers have a way of convincing other farmers to adopt a technology that they have successfully and profitably utilized. This is the basis for the model farmer, model farm strategy. However, this is double-edged; a bad experience by a farmer regarding a certain technology could spread like wildfire and could create reluctance rather than acceptance. However, a sustainable working system being used by a farmer cooperator would enhance receptivity to the mechanization technology.

Revitalizing Government Policies

Reviewing the policies on tax regarding the importation of agricultural machinery and parts (engines, pumps, sprayers, etc.), manufacturing machines (lathes, milling machines, TIG/MIG

welding machines), and all other materials and equipment for the manufacture of agricultural machinery would have a large effect on mechanization. At the same time, the government should try to make arrangements for companies to manufacture the agricultural machines and parts locally. This in effect would also bring down the cost of machinery in the market.

Promoting and requiring all agencies in the development and utilization of agricultural machinery to adopt policies on intellectual property and the Philippine Standards for Agricultural Engineering. Intellectual property laws are created to protect and encourage the development of novel equipment and machinery. Lack of understanding of these laws can be a hindrance to the collaborative efforts between technology-developing institutions and individuals. Legal impediments and protection inhibit researchers and scientists to reveal the exact nature and feature of mature technologies. Adoption of standards, on the other hand, would benefit farmers in terms of safety and reliability of their machinery. Plow bottom, hitching, and most consumable spare parts should be standardized to make it easier to operate and maintain a machinery.

The government should try to control and make policies on the influx of imported, second-hand machinery in the market. This will protect not only the farmers but also the local manufacturers.

Monitoring and Evaluation

There is no sense in developing machines that nobody is using. Technology verification and assessment would permit evaluation for developing, modifying, or entirely stopping the development of a technology. For instance, technology adoption assessment was conducted for the UPLB hand tractor. The study established the potential of the technology and revealed possible modifications to further enhance its performance and acceptability. It also revealed that locally trained manufacturers lacked some knowledge in marketing strategies (Paras et al. 2004).

Custom Hiring of Farming Operations

Instead of buying their own machinery for their field operations, some farmers resort to custom hiring. Operations such as land preparation, harvesting, drying, and milling are mostly the operations available to such services. Payment can be in the form of cash or certain percentage of the harvest. This is currently a viable mechanization relationship between farmers and contractors.

The custom service operation appears to be a workable strategy for promoting mechanization because it is based on a direct client-provider relationship governed by normal market forces. The farmer has power over the provider and can demand quality and value, otherwise the next provider gets the contract. Here, the limited-resource farmer is in control over the essential services provided.

A Second Look at Draft Animals

In past years, animal power has been a neglected option, but government planners, agencies, and the private sector are now taking it more seriously. Animal power should become an integral part of national development strategies, including those relating to food security, resource conservation, rural transport, employment, and women in development. With a favorable policy environment and developmental support, the private sector can sustain and develop animal power technologies, benefiting rural communities and economies. Animal power issues need to be adequately covered in education and training programs and in modern media. Animal power needs to be seen as a valuable and appropriate technology relevant to modern development aspirations (FAO n.d.)

Value Added on Organic Farming

A disadvantage, into an advantage. Our farmers don't have the means to include pesticides, herbicides, and chemical fertilizers in their farm budget. However, there is a growing market for organically grown crops. Helping farmers tap this market could, in the end, lead to more income, more resources, and maybe, mechanization. This is value added on products without adding much on input.

Strengthening Institutional Linkages

Because of the many institutions conducting R&D and extension, there is a need to realign

our objectives and clearly identify each institution's role in the transfer of mechanization technology – complementing, collaborating and sharing resources so as to limit duplication of efforts and minimizing losses to our meager R&D and extension resources.

Mechanization Project

A more comprehensive approach in increasing the transfer of mechanization technologies to small farms is through the mechanization project. Our institution focuses its efforts on promoting agricultural mechanization for small and medium farms, where it adheres to the guiding principle of a "location-specific and production process-dependent mechanization strategies" (Capareda et al. 2002). Location-specific in the sense that technologies brought to the site are appropriate, operational, viable, and acceptable not only to the farmers but also to the environment where the technologies are to be used. On the other hand, production process-dependent mechanization strategies pertain to the mechanization technologies, which could be used by farmers to enable them to perform farming operations efficiently.

The implementation process that our institution is using with collaborative mechanization projects can be seen in Fig. 3.

The premise in this process is that AMDP has the set of appropriate mechanization technologies or can develop or adapt the technology to suit the location-specific condition and production process. Minimum baseline understanding can be obtained through several channels, depending on specific situations and orientation. Probably the most important methodological guideline that

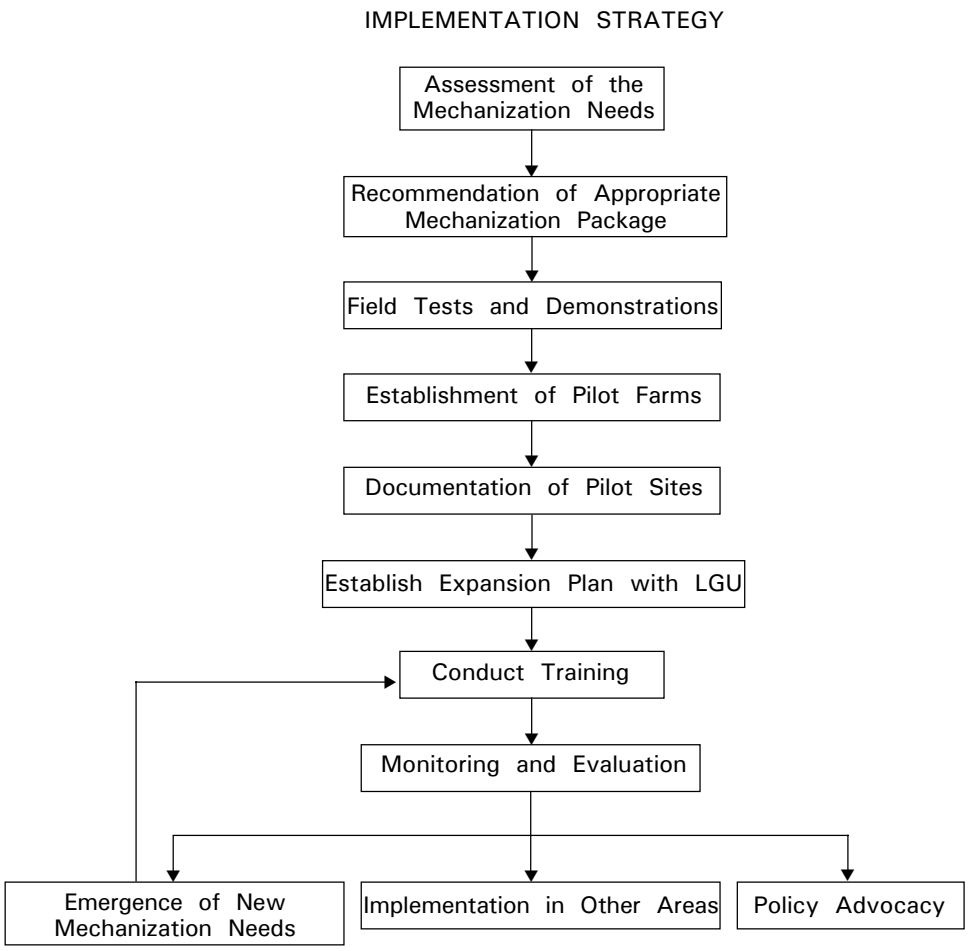

Fig. 3. Mechanization project implementing process.

can be offered is this: the more contact there is among the farmer, the farm, and the scientist, the better is the chance that the scientist will work from a vision of limited-resource farmers beyond stereotypes and statistics. This contact can be obtained through participant observation, process documentation, rapid rural appraisal, group meetings in the field, or the like. In these cases, it is important to get away from the road, to talk to more than the male household head, to actually stand in farm fields, and to go beyond the obligatory ceremonial events and visits by research station scientists (Koppel 1994).

Adopt or adapt?

The most important part of a project is its initial stage. It is where a complete assessment of the needs is gathered through surveys and interviews. This information would be analyzed to become the basis for recommending a mechanization package. In the event that there are no available machines for the specific mechanization need, a short-term R&D subproject will be done to come up with a more appropriate machine. Available machinery could be subjected to some changes to suit the conditions.

The rest of the stages are typical extension strategies. However, there will be instances when new mechanization needs are identified. It is at this time that our institution becomes more involved, taking advantage of the trilogy of functions that we are mandated to perform. In effect, the implementation strategy described is an extension-cum-research approach for extension.

For instance, observations raised by AMDP engineers when they used the UPLB hand tractor for tillage in the upland area of Argao, Cebu, was that the operator had difficulty controlling it due to the uneven depth of the plowed and unplowed part of the soil and terrain. Difficulty with turning at headlands was also observed. They then identified the need to add steering clutch mechanisms to solve the problem. Our institute then made efforts to develop two different prototypes of an upland hand tractor to address the need.

CONCLUSION

After uncovering the barriers surrounding the transfer of small farm mechanization technology and citing possible strategies to break down these barriers, what is needed now is the implementation of the strategies that were suggested.

Discovering a path for developing countries regarding the transfer of mechanization technology to our small farms would likewise be difficult because of added variability of sociocultural, economic, and environmental conditions among countries. Nevertheless, our small farmers are in need of our help. By sharing and learning from each other's problems, we may find other alternative solutions while we try to mimic the success of others in extending mechanization technologies to our small farms.

The commitment of all the stakeholders to uplift the conditions in our small farms through appropriate mechanization schemes can be our starting point. This will definitely be a long ride but from here on, we will only progress and realize our goal if we will all cooperate and accept responsibilities and be accountable to the farmers who need our help.

REFERENCES

Agricultural Mechanization Development Program (AMDP). 2002. AMDP brochure. Institute of Agricultural Engineering, College of Engineering and Agro-Industrial Technology, University of the Philippines Los Baños.

Amongo, R. M. C.2001. Country report for the Philippines on the status of mechanization. Presented in Group Training Course on Farm Mechanization; Japan International Cooperation Agency; Tsukuba International Center, Tsukuba-Shi, Ibaraki, Japan.

Bureau of Agricultural Statistics. 2004. Selected statistics on agriculture. Farm size and classification. Retrieved 29 April 2005 from http://www.bas.gov.ph

Capareda, S.C.; J.D. de Ramos; A.C. del Rosario; S.G. Castro. 2002. Mechanization of small to medium scale corn production areas in the Philippines. In: Implementation strategy manual. Agricultural Mechanization

Development Program (AMDP), Institute of Agricultural Engineering, College of Engineering and Agro-Industrial Technology, University of the Philippines Los Baños.

David, C.C. 1995. Philippine agricultural research and development: issues and policy implications. Philippine Institute for Development Studies. Discussion paper series No. 95-27. Retrieved 29 April 2005 http://www.pids.gov.ph/.

Encanto, V.S. 2000. The flow of information in the national extension system, and current information needs: the Philippines. Food and Fertilizer Technology Center. Retrieved 29 April 2005 http://www.fftc.agnet.org.

Food and Agriculture Organization. 2000. Retrieved 19 April 2005 http://www. FAOAG21MagazineSpotlightDraught animals.htm.

Koppel, B. 1994.Old images and new challenges: rethinking the mission of agricultural support in Asia. Journal of Philippine Development 38,21:279-280, 293. Retrieved 16 April 2005 http:// www.pids.gov.ph/.

Lantin,R. M. 1985. A Review of past, present and proposed mechanization strategies in the Philippines. Journal of Philippine Development 21,11:1. Retrieved 19 April 2005 http://www.pids.gov.ph/.

Lantin, R. M.; M.V. L. Larona; R. M. C. Amongo. 2003. Land consolidation efforts for corn farms in the Philippines. Philippine Agricultural Mechanization Bulletin, Agricultural Mechanization Development Program. 10,2:3,6.

Rodulfo, V.A. Jr.; B.C. Geronimo. 2004. AMDP presents R&D prospects and SCU's role in Philippine agriculture and fisheries modernization. Philippine Agricultural Mechanization Bulletin, Agricultural Mechanization Development Program. 10, 2:3-6.

Paras, F. O. Jr.; B.L. Paita; A.A. Blastique. 2004. Technology adoption assessment: the case of the UPLB differential type hand tractor. Mechanization Update. Agricultural Mechanization Development Program 10,2:4.

Philippine Council for Agriculture, Forestry and Natural Resources Research and Development (PCARRD)-Department of Science and Technology (DOST). 2002. R&D status and directions (2000 and beyond): agricultural engineering. Los Baños, Laguna: PCARRD-DOST.

PCARRD-DOST. 2002. R&D status and directions (2000 and beyond): applied rural sociology. Los Baños, Laguna: PCARRD-DOST.

RASCP-TA Central Management Office. 2002. Rural farmers and agrarian reform support credit program: Project completion report. p. 43.

Salokhe, V.M; A. Oida. 2003. Development of appropriate agricultural machinery for Southeast Asian countries. Laboratory of Agricultural Systems Engineering. Retrieved 16 April 2005 www.fsao.kais.kyoto-u.ac.jp/ guest_prof/Salokhe_report.pdf.